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Vol. XXXVI March 1949 No. 3

Editorial

Ceiling Prices and Cost of Production: In the December issue of the Madras Agricultural Journal, we published an article from a contributor from Tinneveli, on the economic price of paddy. A correspondent from South Canara whose letter is published elsewhere in this issue takes us to task for publishing the article without our comments. We may state at once that as a general rule the Editorial Board does not hold itself responsible for the opinions expressed by its contributors, nor can it vouchsafe for the correctness of the figures furnished by them in supprt of their opinions. But in this particular instance it so happens that we agree with the main contention of our Tinneveli contributor viz., that when ceiling prices are fixed by the Government due consideration should be given to the cost of production and at the same time the cultivator should be guaranteed a reasonable margin of profit. To this proposition no one could take any objection. But divergent opinions may be justifiably held regarding the actual cost of production in relation to different crops and in determining what constitutes reasonable margin of profit. We hold that the figures by Mr. A. Chidambaram Pillay with regard to cost of cultivation are reasonable. The price of land which has been taken at Rs. 6,000 in the Tinneveli district, we believe, is the prevailing price obtaining in the locality. The tract is very fertile and the yield of 5,600 lb. per acre is about the highest in the Province

Now as regards the margin of profit, we note that Mr. Pillay has added Rs. 270 to the cost of cultivation representing 4½% interest on the capital outlay and allowed a margin of 5 kottas per year against bad years. The question arises whether 4½% is a reasonable rate. Considering that in other enterprises this rate of dividend is normally obtained and taking into consideration the prevailing bank rates many of our readers will agree that the rate fixed by Mr. Pillay is not unconscionably high. For, be it noted that the entire profit to the cultivator is merged in this amount and there is no reason why the producer

of food should be at a disadvantage in comparison with producers of other commodities. But then food should be produced and made available to the consumer at prices which he can afford. Here comes the difficulty for the Government in fixing ceiling prices, and the periodical revisions of prices bear evidence to this difficulty and every attempt is made to reconcile the interest of the consumer and producer to the extent possible under given set of circumstances.

Mr. Savur has stated that he has been able to secure land at Rs. 60 an acre and he finds his agricultural enterprise profitable, but he forgets that the ceiling price of paddy in his district is more or less the same as in the districts where an acre of land costs one hundred times more. From what we know of the Tirunelveli cultivator, we do not consider him less efficient or less enterprising than cultivators in other parts of the Province. Cost of land and labour varies within wide limits in our Province and is dependent on various factors over which the cultivator has no control and therefore it is inevitable that the margin of profit also varies from tract to tract when a more or less uniform selling price is fixed for the entire Province.

Our Agricultural graduates: We understand that many of the Agricultural graduates who passed out last year still remain unemployed. One would have thought that the last group of persons to remain unemployed under the present circumstances would be those who have equipped themselves with special knowledge in Agriculture. Not a day passes without some important person or other, making a statement about the 'food crisis' and the need for increasing production. Plans and schemes there are in plenty and we believe it is intended that some of them should be implemented. The plea that schemes are being held up for lack of trained personnel cannot be advanced in this instance, and it will be agreed that the alumni of the two Agricultural colleges in the Province have justifiable reasons to feel frustrated, if their talents are not utilised in this emergency. While in normal times Government cannot undertake to provide employment for every graduate who takes his degree in Agriculture, we are of opinion that the present crisis warrants the absorbtion of all available talent for furthering the cause of increased food production.

A Soil Survey for Fruit Development in the Ceded Districts

By

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and

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Introduction: The importance of the fruit industry and its great value to the health and economy of the country have received adequate attention only in recent years and with the aid of grants from the Indian Council of Agricultural Research several fruit research stations have been established all over the country. The climatic, soil and water conditions over several areas in this presidency are so favourable that considerable extension of the area under fruits is possible. The per capita consumption of fruits is very low in this country. It is recognised that fruits, in addition to forming a wholesome article of diet, are good sources of vitamins and minerals, provide bulk and possess laxative properties. The higher income per acre from land devoted to fruits must be an additional inducement for the extension of the area under fruits. Incomes of as much as Rs. 5,000/- per acre have been obtained in some of the cheeni growing areas in the Ceded Districts. A family can earn a living from a smaller area devoted to fruits than would be required were ordinary farm crops grown. The development of the fruit industry would thus have far-reaching consequences on the health and economy of the country.

Scope of the survey: The object of the survey was to assess, from an examination of the soil and subsoil layers, drainage and facilities for irrigation, the suitability of the following areas in the Ceded Districts for fruit cultivation :—

	Area.	*Taluq.*	*District.*
1.	Kottur-Ujjini	Kudligi	Bellary
2.	Rudravaram	Sirvel	Kurnool
3.	Giddalore-Diguvameta	Cumbum	Kurnool
4.	Vontimitta Valley	Sidhout	Cuddapah
5.	Kodur Firka	Rajampet	Cuddapah

Field work: Preliminary traverses of the areas were made before deciding on the location of the pits so that the soil samples taken would be representative of as large an area as possible. The profile pits were generally dug to 8 feet depth except in cases where either the water table or hard rock was met with earlier. The exposed layers of soil were then examined and samples representing each foot depth of

soil generally taken. Field notes were recorded regarding the nature of the soil at various depths, the drainage, facilities for irrigation, potentialities for sinking wells, the depth of the water table in summer and in the rainy season and the quality of the water. Samples of water from irrigation sources were taken for analysis. Samples of soils and water were also taken from existing orchards, if any, in the areas surveyed

80 profile pits were dug and 426 samples of soil and 51 samples of water were taken and despatched to Coimbatore as shown below:—

Area	No of profile pits	No. of soils samples	No. of water samples.
1. Kottur-Ujjini	15	61	6
2. Rudravaram–Sirvel	18	93	8
3. Giddalore-Diguvametta	14	76	11
4. Votimitta valley	15	71	12
5. Kodur Firka	16	109	12
6. Panyam	2	16	2
Total ...	80	426	51

Brief accounts of the salient features of the various areas are given below :—

1. **Kottur-Ujjini**: There is an attractive stretch of red-soil area on either side of the Kottur-Ujjini road. The red soils are mainly derived from granites with pegmatite veins. On the ridge lines it was not uncommon to find the surface strewn with quartz fragments as big as hen's eggs. Over the greater portion of the area the soils are of very poor depth (2-3 ft.). The surface soils are sandy to sandy loam in texture but the subsoils are heavier. The soils in the valley lines are deeper (5–7 ft.) and heavier and the colour reddish–brown. Near Ujjini shallow, heavy black soils are met with. Irrigation wells in the area are few ; the water table is very low (over 60 ft.) and the water brackish. In view of the very low water table the cost of sinking wells is high, an irrigation well easily costing Rs. 2,000/– and there is no guarantee of the supply of sweet water. In the valley lines as at Kalapuram the water table is more favourable, being situated at 40-45 ft. and the quality of the water fairly good. These somewhat favourable conditions are confined to small and very restricted areas and over the major portion of the area, water supply is the biggest problem, no other sources of irrigation being available. It is no

wonder, than, that orchards are not to be seen anywhere in the area. The gently rolling nature of the country and the topography are favourable to drainage. Considerable soil erosion is in evidence. In common with the western taluqs of the Bellary District, the locality receives higher rainfall than the remaining portions, the average annual rainfall being 25" mostly favoured by the S. W. monsoon (June to September). As regards transport facilities Kottur is well connected by road and rail with Hospet and Bellary. But the Kottur-Ujjini road is very bad and requires considerable improvement.

Rudravaram—Sirvel area: Rudravaram is situated at the foot of the Nallamalais and is about 10 miles from Allagadda, the taluq headquarters and 9 miles from Sirvel. The outstanding features of the Rudravaram—Sirvel area high water–table and good water. Sirvel and the surrounding villages have large areas under fruits and are well known as an important fruit–producing centre. In view of the considerably higher returns per acre from land devoted to cheeni culture there has been considerable extension of the area under fruits in recent years in Sirvel. In Rudravaram just the beginnings have been made.

The soils of the area are mostly derived from Cuddapah formations. The surface soils are generally brown in colour and loamy in texture and the subsoils are yellowish–brown and heavier in texture with very often high proportions of rounded ferruginous gravel in the deeper layers. In and around Sirvel the soils are comparatively shallow, rocks of the Cuddapah formations being met with at the third or fourth foot. In spite of the comparatively shallow soils and high water table (reaching to within 4-5 ft. in the rainy season) which are far from ideal conditions from the point of view of commercial fruit culture, some flourishing orchards are seen in the area and net profits of as much as Rs. 5000/- per acre have in some instances been obtained from Cheeni gardens. In view of the high water table the gardens will naturally be characterised by a short life All the cheeni gardens in the area are comparatively young and it remains to be seen how the high water table will affect the life of the fruit trees. The high water table is also believed to lead to the fruits being insipid and the keeping quality poor. In spite of these adverse factors, there has been considerable extension of the area under fruits due chiefly to the considerably higher returns from land devoted to fruits. In the Rudravaram area sufficiently deep soils for profitable fruit growing are met with. There are stretches of red soils, sandy loam to loamy in

Kodur: The average annual rainfall of this area is 38", about one third of this being received in the S. W. monsoon period and the remaining two-thirds in the N. E. monsoon period. Kodur is well known as in important fruit-producing centre and famous for its Sathgudi oranges, limes and mangoes. There are about 7,000 acres of cheeni gardens and 10,000 acres of mango gardens in Rajampt taluq and the contribution of Kodur firka to the area under fruits in the taluq is quite considerable. The outstanding feature of the area is the occurrence of very deep soils (more than 8ft.) over the greater portion of the firka. The soils are mainly derived from quartzites and are in general red to reddish-brown in colour and loamy in texture right down to 8 ft., thus permitting good root developement. Being derived from quartzites the soils are comparatively poor soils, lacking in the essential plants nutrients. Their success for fruit growing must be attributed to the good depth and favourable physical properties. The water table is quite favourable, being situated at 20-30 ft. and the quality of the water good. Wells form the main source of water-supply for the areas under fruits. The area surveyed includes the following villages: — (1) Pagadalapalli, (2) Rachapalli, (3) Balireddipalli, (4) Satram, (5) Reddivaripalli, (6) Kichchamma Agraharam, (7) Chiyyavaram, (8) Kapupalli, (9) Anantarajupeta, (10) Mangampet, (11) Settigunta, (12) Janakipuram, (13) Maisurivaripalli. In Settigunta there is a compact block of 600 acres of waste land and the utilization of this area for a land colonisation scheme was purposed some time back. It is understood that trial borings by the Industries Department to tap sub-soil water did not meet with success and the scheme has been given up. Kodur is well connected by rail with good marketing centres for fuits but the road communications in the area require considerable improvement.

Panyam: With a view to getting an idea of the conditions obtaining in an ideal orchard and comparing the analytical data with those obtained for the soils collected in the course of the survey, soil samples were drawn from the famous Jaganmohini and Manoranjini gardens of Messrs P. V. Madhava Rao and brothers of Panyam, nurserymen and horticulturists of repute. One pit was put in the mango garden area, which consists of sandy soil and the other in the cheeni garden area which consists of very rich black loamy soil. The soils in both areas are of considerable depth, possess ample natural reserves of calcuim carbonate and are well-drained soils, the water table being situated at 40 ft. There are practically no wells in the area and the orchards and wetlands are supplied with water by a big tank fed by

a perennial spring from the Erramalai hills and the water is excellent in quality. Water is not available for irrigation throughout the year.

An interesting sample of incrustation that forms on the black soils round about the tank during the summer and which is gathered and applied as manure to cheeni trees which are said to benefit considerably from the application, was collected and analysed. The incrustation has been found to contain 0.65% of nitrogen (practically the whole of it in the form of nitrates), 0.59% of P_2O_5, 3.1% of lime and 1.34% of potash. The water-soluble salts amount to 5.6%, nitrates and chlorides, accounting for the bulk of the salts.

Before proceeding to discuss the results of laboratory examination of the soils it would be useful to review briefly the literature on fruit soils.

Chief among the characteristics desirable in orchard soils are good depth and texture providing for extensive root development and the maintenance of continuously favourable moisture conditions in the soil, freedom from hardpan or impervious strata and good aeration and drainage and freedom from soil alkali and salts.

Texture: The texture of the soil is an important consideration as it determines largely the drainage. The soil must have sufficient body to retain water but it must at the same time drain off the surplus. Sandy soils which are apt to dry out too quickly and lack the essential plant food elements and heavy soils are in general, not suitable. The ideal fruit soil is a light loam of good depth, varying but slightly in the first four feet and well-drained (7).

Although the texture is an important consideration it is impossible to attempt a definition of the soil requirements of fruit trees in terms of mechanical analysis. Experience shows that most fruit trees are not particular as to soil type and are found to thrive on a wide variety of soils, ranging in texture from sands to heavy loams. It is interesting to note that the soils of the Florida coast, famous for pineapples contain 98% of sand. Although the ideal texture is a loam, sandy loams or even sands and heavy soils may be suitable for fruits where favourable moisture conditions are present and where the topography favours drainage (2).

Depth of soil: Most fruit trees have a comparatively deep root system. The extent and depth of the root system has an important bearing on the productiveness and length of life of the fruit

trees. The deeper the soil and the more suitable the texture, the greater the development of root system. The minimum depth of soil for most fruit trees is considered to be 5 ft. There are many instances known in which soils are favourable for fruits simply because of the extensive root development they allow rather than fertility or moisture-holding capacity (6).

Drainage: Fruit trees are very sensitive to poor drainage and cannot stand 'wet feet', Thorough æration and drainage are, therefore, very important. The soil must be free from hardpan or impervious strata and no ground water must be present in the surface four feet except shortly after heavy rain. (6). It was found by Oskamp that in New York fruit growing area, the limiting factor was drainage rather than soil fertility (7). The colour of the soil gives an excellent indication as to its suitability or otherwise for fruits. In the case of well-drained and ærated soils the colour is more or less uniform. If the drainage is defective characteristic mottlings are noticed in the deeper layers of soil (7, 8).

Moisture conditions in soil: Fruit trees require continuously favourable moisture conditions throughout the growing season. The moisture content of the soil, its amount and availability throughout the growing season has been found to be of greater importance than any other factor (10).

Importance of physical conditions: Broadly speaking the physical condition of the soil is more important for fruit production than its content of the essential plant food elements. The most favourable soils are not necessarily the most fertile soils (2, 10). A survey of orchard soils in Quebec has shown that a very productive soil for farm crops may not be quite suitable for fruits and conversely a comparatively poor soil in good physical condition may give excellent results with fruits when properly fertilized and managed. If the physical condition of the soil is favourable, a good growth of fruit trees is often secured out of all proportion to what would be obtained from farm crops on the same land (6). Differences in individual tree growth and productiveness are commonly noticed in orchards and these differences have frequently been traced to variations in such factors as texture, drainage etc. rather than plant food content (2). Wallace from an analysis of the soil and pomological data obtained for West Midland soils in England comes to the conclusion that striking correlations exist between soil conditions and tree growth and that the soil conditions associated with success or failure in fruit trees are

mainly physical in character (13). Thus special emphasis is laid on the physical characteristics of the soil — depth, texture, drainage and favourable moisture conditions.

Water soluble salts: Most fruit trees are injuriously affected by more than 0·2% of salts in the soil. According to Coit less than 0·1% is considered safe. Saline irrigation waters are also detrimental.

Fruit soils considered from the chemical standpoint: Fruit trees require for their growth and development large quantities of nitrogen and potash and only small amounts of phosphates (4, 12).

Nitrogen: In considering the manurial requirements of fruit trees nitrogen is easily the most important and perhaps the only element needed for the most orchard areas. Fertilizer experiments carried out in U. S A. and Europe have demonstrated that nitrogen in a readily available form is the only element of plant food that is uniformly a factor in the favourable responses when such are secured. Very high nitrogen content of the soil results in rank vegetative growth and decreased yields. Irrespective of the amount of nitrogen present, fruit trees have been found to thrive only when an adequate supply of organic matter is maintained in the soil (4).

Potash: The potash requirements of fruit trees are undoubtedly high and the importance of an adequate supply of potash for the nutrition of fruit trees is recognised. Most orchard soils, however, contain sufficient amounts of this element to make the application of it unnecessary and the use of potash is confined to more or less restricted areas where the deficiency is extreme. Nitrogenous manuring is ineffective or even harmful in the absence of adequate amounts of potash (11).

Phosphorus: The phosphorus requirements of fruit trees are quite low and on account of their deep-rooting habit fruit trees are able to obtain their requirements from the natural supplies in the soil. Fertilizer experiments have demonstrated that fruit trees are not directly benefited by the application of phosphates unless the deficiency is extreme (3).

Chemical analysis of soil: The chemical composition of soils as determined by the present methods of analysis does not afford an accurate guide as to their suitability for fruit growing. Soils that are unproductive from the point of view of ordinary farm crops are often found productive for fruits. Wallace (13) has shown that no correlation could be traced between the contents of plant food elements

in the soils and tree growth. Stewart has analysed the response to fertilizer applications of trees growing in soils of varying productivity and comes to the conclusion that the correlation between the fertility status of the soil as determined by soil analysis and the response to fertilizers is exceedingly slight or absent. In fact the least response to fertilization was found in the soil analysing the poorest of all and some of the largest responses were found in the case of the chemically richest soils. Thus the relationship between the chemical composition of the soils and their suitability for fruit-growing is very little understood (2).

Soil reaction and lime content: Most fruit trees are tolerant of a wide range of soil reaction and are not so sensitive as are many of the ordinary field crops. Surface soils varying in pH from 4·5 to 7·5 have been used and no definite correlation between good or bad growth and pH could be traced within this range (10). The bulk of experimental evidence points to the fact that fruit trees rarely respond to applications of lime. Wallace in his survey of the fruit soils of West Midlands found excellent tree growth both on soils containing natural reserves of calcium carbonate and on others showing lime requirements (13). Lime was considered essential for stone formation in stone fruits and was widely used for all kinds of fruit trees in the past. In view of the fact that fruit trees rarely respond to lime and excellent tree growth occurs even on somewhat acid soils, provided adequate amounts of potash are present regular or heavy applications of lime are considered unnecessary. (11).

Citrus, however, is considered to be calcicolous in nature and its lime requirements are high. Adequate potash may compensate for lime deficiency (9). In Florida the best quality citrus orchards are invariably found on soils with good reserves of calcium carbonate. In California the citrus soils all tend towards alkalinity. The best quality citrus in U. S. A. is grown on arid soils in Arizona. In Italy and Spain the citrus soils are of the *terra-rosa* type rich in lime and often calcareous. In Nagpur oranges are grown on rather heavy black soils rich in lime and underlaid with '*murrum*' (gravelly subsoil) which provides good drainage. The soils of the most important citrus growing areas are thus well supplied with lime and this is supposed to contribute to the success of the orchard (4).

Analysis of soils, and waters: In view of the requirements of fruit soils stated above the laboratory examination of the soil samples has been confined to the following: — (1) content of water-soluble-salts by the electrical conductivity method for all samples,

)2) Natural reserves of calcium carbonate (qualitative) for all samples, (3) Mechanical analysis by the International method for roughly half the number of samples, (4) Loss on ignition, nitrogen, lime, total potash and phosphoric acid, available potash and phosphoric acid and pH in 35 selected surface samples.

The location of the profile pits in the various areas is shown in maps 1 — 5. * The field observations and profile characteristics, the percentage of stones and gravel, the content of water-soluble salts and information regarding the natural reserves of calcium carbonate in the soils are given in Appendix I. The results of mechanical analysis are contained in Appendix II. These results relate to the 'fine earth' obtained after the removal of stones and gravel (particles greater than 2. mm. diameter) in the preparation of the soil sample for analsis. As will be seen from Appendix I, stones and gravel often form large proportions of the soil and to obtain a good picture of the physical conditions in the soil, the results of mechanical analysis must be read in conjunction with the precentage of stones in the sample. The results of chemical analysis and the pH values of the selected surface samples are set out in appendix III, while Appendix IV gives the results of analysis of the water samples.

The soils of the areas surveyed are, in general, characterised by an extremely low content of water-soluble salts. Exceptions are the black soil area near Ujjini (Kottur-Ujjini area), the area near Vakkileru in Rudravaram, the area round about Kanchipalli village (Giddalore-Diguvametta) which is definitely alkaline and sticky, and Balireddipallo in Kodur firka.

As regards lime status the soils from the Vontimitta and Giddalore areas are well provided with lime. The soils from Rudravaram and Kottur areas contain fair amounts while the Kodur soils are generally extremely poor in lime. Data regarding the number of soils tested and the number which showed effervescence on the addition of dilute acids are given below :

Area	No. of soils examined.	No. of soils showing effervescence.	No. of soils showing no effervescence
1. Kottur-Ujjini	60	22	38
2. Rudravaram	93	55	38
3. Giddalore-Diguvamitta	77	63	14
4. Vontimitta	70	53	17
5. Kodur	109	10	99

* The maps and appendices will be published in the next issue of the Journal.

The total lime content of some selected surface samples from the various areas surveyed is given in Appendix III.

As regards the content of the essential plant food elements, Vontimitta and Giddalore areas are very rich in potash. Except perhaps, the soils of Vontimitta, the soil samples examined have an extremely low content of phosphoric acid, both total and available. The soil from the cheeni garden area, Panyam is a very rich soil, containing as it does 0·12% of nitrogen, 0·55% of phosphoric acid, 0·98% of potash and 3·7% of lime.

The pH values of the soils generally range between 8 and 9, typical red soils showing lower values.

As regards the water samples the well waters from Rudravaram, Vontimitta and Kodur are very good while those from Kottur and Giddalore areas are of somewhat high salt content and of doubtful quality for the irrigation of fruit trees. It will be seen that some water samples from irrigation sources which will be of no use whatever as far as the areas surveyed are concerned have been collected. From Giddalore some water samples have been taken from bore wells which provide drinking water. Taking into account only the wells used for irrigation purposes and in the light of the information gathered during the survey regarding the quality of the water, the above conclusion seems to be justified.

Suitability of the sites for fruit cultivation: In the light of the information available with regard to soil and water conditions in the five sites surveyed, their suitability for fruit cultivation is discussed below:—

1. *Kottur-Ujjini.* In view of the fact that the soils over the greater portion of this area are comparatively shallow, the water table very low and the water brackish, this area is not considered suitable for fruits.

2. *Rudravaram.* The favourable features of this area with regard to the water table and good quality of water have already been referred to. In the stretches of red soil area extending along the foot of the hills near Rudravaram, the water table is neither too high nor too low and the conditions are quite favourable. Over the remaining portions of the area sufficiently deep soils for profitable fruit cultivation are met with. The water table is, however, somewhat high and this may adversely affect the life of the fruit

trees. Reference has already been made to the fact that a great impediment to the development of the area is the lack of adequate road communications.

Diguvametta–Giddalore. Except near Diguvametta where the soils are shallow, the soil conditions over the remaining portions of the area are favourable. The greatest drawback to the development of the area is lack of irrigation facilities, the water table being very low. The civic Association of Giddalore have sent up a memorial to the Collector of Kurnool, praying for irrigation facilities by improving Vemulakunta and by damming the Sagileru stream at Kattiralabanda. These improvements, if effected, will benefit only an area of about 300 acres and any large-scale development of the area will necessarily have to be dependent on the tapping of subsoil water supplies. About half-a-mile northwest of the level crossing between Diguvametta and Giddalore two new wells have been sunk recently. The water table was found to be 20-25 ft. in the rainy season and the quality of the water fairly good. The supply of water from the wells is reported, however to be poor, being just enough for 1-2 acres under vegetables and chillies. It is possible that if tube wells are sunk adequate supplies and better quality of water may be available. The development of the area is intimately bound up with the availability of adequate and good subsoil water and for deciding this question trial borings will be necessary. As things stand at present, any large-scale and economic development of the area for fruits does not appear to be feasible.

4. *Vontimitta.* Mention as already been made of the fact that there is considerable erosion in this area and that the stretches of good soil are nowhere extensive. There is therefore, very little prospect of any large-scale extension of the area under fruits. There are, however, small but quite appreciable areas of suitable soil in all the villages surveyed, especially in Nadimpalli, Cherlopalli, Kottapalli and Mantapampalli which can be brought under fruits. The area is characterized by a high water table and very good water.

5. *Kodur.* The most characteristic feature of this area is the occurrence of deep soils (more than 8 ft.) over the greater portion of the firka. The water-table is neither too high nor too low and the quality of water good. The drainage is also good. The conditions are, therefore, very favourable for considerable extension of the area under fruits. The waste land near Settigunta is not considered suitable as the soils are of poor depth and subsoil water very low.

Summary:

1. The salient features of the five sites with regard to soil, water and other conditions are given.

2. The literature on the subject of fruit soils has been briefly reviewed.

3. The results of the laboratory examination of the soil and water samples are discussed.

4. In the light of the above information the suitability of the various areas for fruit growing is discussed.

In conclusion the authors wish to accord their thanks to Sri P. D. Karunakar M. Sc (Rutgers), A. R. I. C., the Government Agricultural Chemist for the interest he took in the work and for helpful suggestions.

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ANNOUNCEMENT

The Ramasastrula - Munagala Prize, 1949

1. The prize will be awarded in July 1949.

2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, carried out by him on any agricultural science.

3. The subject matter shall not exceed in length twelve foolscap pages, type-written on one side.

4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union not later than the 1st June 1949 with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a *nom-de-plume*.

5. Four type-written copies of the essay should be sent.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.

7. Paper or papers accepted will become the property of the Union and the Union reserves to itself the right of publishing all or any of the papers.

8. All reference in the paper to published books, reports or papers by other workers must be acknowledged.

9. Any further particulars may be obtained rrom the Secretary, the Madras Agricultural Students' Union, Lawley Road P. O., Coimbatore.

K. Meenakshisundaram,
Secretary.

Seed Pre-Treatment for Improving Germination in some Cultivated Plants

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Where there are no other known methods of propagation, propagation by seed is the rule in the case of many economic plants. In view of this feature, the study of the several aspects of seed germination begun with the dawn of the present century continues with an unabated interest. Valuable evidence has accumulated on several factors relating to germination viz., temperature, light, moisture etc. Interest in such problems as those of seed viability and light sensitivity led several workers to study the light and temperature relations of germination. Haberlandt (1875) was the pioneer to study over 70 agricultural plants and found that the optimum temperature and germination requirements of seeds varied considerably. He then correlated the time relations of germination with temperature and light sensitivity of seeds.

In subsequent years, it was found that dormancy and after-ripening of seed present a new set of problems in the study of seed germination. Dormancy and impermeability mostly associated with hard coated seeds acting as barriers in their germination have handicapped their rapid spread even when favourable conditions existed. It is known that dormancy in seeds is due to one or a combination of several factors, viz. impermeability of seed coat, mechanical resistance of the seed coat, impermeability to oxygen, immature embryo etc. Several methods in the past have been tried by investigators to overcome these barriers. The treatments that have been commonly used to hasten germination and overcome impermeability in hard coated seeds are scarification, dry-heat, freezing and thawing treatment with chemicals, placing under conditions favourable to after-ripening etc.

Among these, scarification or wearing down the hard seed coat is the common pre-treatment widely adopted. Rose (1915) found that hard-coated seeds of legume, *Hibiscus esculentus* and mustard could be made to germinate by being blown against needle points. In some seeds scarification is reported by Wolfe and Kipps (1926) to reduce their longevity.

Among chemicals, carbon-di-sulphide, ether, ethylene-di-chloride, sulphuric acid, etc., have been recommended to overcome low germination of impervious seeds by the softening of the seed coat. Jones (1928) found

that the seed coats of *Nelumbo lutea* require a five hour treatment with sulphuric acid for facilitating their germination. Brown (1933) has reported that de-linting cotton seeds with sulphuric acid gives an increased rate of germination and 20 per cent increase in yield over the controls. Vapours of ethylene chlor-hydrin have been used to stimulate germination in hard-coated maple, oats, etc., by Deuber (1931) and Bramble (1932). A few other hormones have also been successfully tried by Mc Rostie and Hopkins (1938), Templeman (1939), Gracinin (1928) and others.

Certain physical means have also been effectively used by several investigators to induce germination in hard-coated seeds. Anderson (1931) obtained very high germination with seeds kept in darkness in dilute nitric acid. Germination in monkey flower *Mimulus ringens* was found by Hutchings (1932) roughly proportional to the intensity of light. Similar light sensitivity of seeds in germination has been brought out by Thornton (1936), Thompson (1935) and Flint (1934). Liquid air, partial pressure, alternation of temperature are other physical means that have been adopted by Bussee (1930) Harringron (1916), Midgeley (1926), Stewart (1926) Flemion (1931), Fivaz (1931), Moringa (1926) and a host of others to induce permeability in lucerne, celery, parsnip, flax, Bermuda grass etc. But certain abnormalities have been noticed by Busse and Burham (1093) in the use of the above treatments.

The literature on temperature relations of seed germination by Edwards (1932) gives a critical review of the optimal temparature relations and their significance in seed germination. Tang (1931) found that wheat seeds in general gave higher percentage of germination with higher tempe- ratures, after which at still higher degrees lower germinations was recorded. Livingston and Haasis (1933), Barton (1932) Robbin and Petch (1932) are a few of the investigators who fixed up certain optimum temperatures for seed germination ranging between 30 to 25° C.

Most of the methods suggested by the above investigators stipulate the use of some complex technique and costly equipment. These are not possible for easy adoption on a popular scale, on account of the cost and lack of scientific knowledge about treatments. In order to overcome these drawbacks certain standard seed testing and germinating plants and other skilled establishments have been set up in foreign countries

Initially a few of the above methods were employed to overcome im- permeability and laboratory trials were underway with several hard-coated seeds of economic plants which are known to be poor germinators. Mainly heat by means of water at various temperatures was applied by steeping seeds for limited intervals of time generally not exceeding five minutes and the encouraging results obtained in their germination are described in this article.

1. *Lucaena glauca* (*Nagarikesari*). This is a small tree belonging to *Mimosoidae* having very wide distribution in this province. Its quick growth and response to pruning have made it suitable as a green leaf manure plant for paddy.

The seeds are dark brown and possess a shining hard testa or seed coat. They germinate very slowly and generally the germination does not exceed 20 per cent. After pre-treatment with hot water for five minutes at different temperatures the following germination was secured in repeated trials.

Temperature :	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C
Mean germination per cent	24	30	37	56	78	74	3	...

Temperature between 70 to 80°C is found to cause the seed coat swell and facilitate over 70 per cent germination. Immersion for longer intervals does not induce further permeability to any appreciable degree and at higher temperatures the embryo is devitalized.

2. *Tephrosia purpurea : Wild Indigo or Kolingi or Vempali.* This is a green manure plant generally sown immediately after the harvest of paddy. The seeds are small, mottled, hard coated and are poor germinators. Realising this, Chandrasekhara Iyer (1940) has suggested sand papering for scarifying these seeds. Pounding the seeds with sand is also commonly advocated. By steeping these seeds directly in hot water at 90°C for five minutes, over 65 per cent germination has been secured within two days of the treatment, as against 10 — 15 per cent obtained with untreated seeds. The germination secured at different temperatures for the same interval of time is as follows.

Temperature : ...	70°C	80°C	90°C	100°C	Untreated
Mean germination per cent	51	41	74	45	13

Scarification by sand papering or pounding with sand have certain limitations. Steeping in hot water is feasible on a bulk scale and uniformity of treatment with minimum effort and labour merit this as a better treatment compared with the other methods. Where quick germination is needed through economic and feasible means on a large scale to utilize the rapidly decreasing moisture after the harvest of paddy, this method lends itself admirably in forcing maximum germination in a very short time.

3. *Crotalaria juncea* sunnhemp. This is one of the quickest growing green manure crops widely used for several agricultural crops all over the province. The seeds are kidney shaped, purple to dark brown

in colour and possess a shining coat of moderate thickness. Pre-treatment with hot water at 70°C for five minutes before sowing has given as much as even cent percent germination within a day as against 80 to 90 percent obtained with untreated ones.

The germination obtained at different temperatures for the same interval of time within 24 hours is as follows.

Temperature ...	70°C	80°C	90°C	100°C	Untreated
Mean germination per cent	96	86	81	4	84

To force almost cent percent germination without any deleterious effects in a single day, pre-treatment with hot water at 73°C for five minutes is an economic and feasible method to ensure maximum germination. Through such quick germination achieved by pre-treating the seed, the seedlings are enabled to establish immediately with the available moisture which rapidly decreases after crop harvets or under dry or rainfed conditions.

4. ***Prosopis juliflora*** (Mesquite). This is an introduced quick growing plant which possess the desirable qualities of a hedge. Its quick growth, response to drastic pruning, thorny nature and bitter taste of leaves enabling it to ward off the ravages of goats and cattle and rank it as one of the best hedge plants suited to our conditions, though exotic in origin. Its propagation has presented serious difficulties both on account of its hard coated seeds and the leathery nature of the fruit impeding rapid seed extraction.

The pods are spongy with thick juicy pericarp. This can be softened by treatment with 1 : 4 sulphuric acid added just to wet the seeds and after 15 minutes the acid is diluted with enough water to cover or soak the pods completely and this is left to stand overnight. During this interval the acid corrodes and softens the pericarp without injuring the seeds enclosed in it. In one drying, the pounding is facilitated and the seeds are easily extracted. It has been found that the acid treatment is absolutely harmless and not inhibiting germination and at the same time costing not more than one anna per lb.

Direct pre-treatment of the seeds with hot water is not effective as scarification. Nambiar (1944) has stated that germination could be highly improved by shaking the seeds with sand in metal containers. About 65 per cent germination can be secured by this method within three days as against 10 — 15 per cent obtained without pre-treatment. Seeds scarified with sand when treated with hot water at 70°C for five

minutes give generally ten per cent higher germination than that secured with mere scarification. Within three days it is thus possible to secure over 75 percent germination by adopting the above two methods.

5. *Delonix regia* (*Gul Mohr*). This is an avenue tree found all over the province. The seeds are cylindrical, long, hard and tapering at ends. Treatment of these seeds in hot water for five minutes at varying temperatures gave the following germination within a fortnight.

Temperature ...	60°C	70°C	80°C	85°C	90°C	100°C	Untreated
Mean germination per cent	37	48	69	75	44	49	24

Direct steeping in hot water between 80 to 85°C gives about three times higher germination than that of untreated seeds within a fortnight. The testa or seed coat wears down into thin wavy films and facilitates the absorption of water and the quick germination of the embryo.

6. *Delonix elata*. This is an avenue tree found largely in the several regions of this province resembling almost *Delonix regia* and popularly known as Chittikeswari in Telugu. The seeds are flat, hard and possess dull metallic lusture. With similiar pre-treatment in hot water for five minutes at varying temperatures the germination obtained is tabulated below.

Temperature ...	60°	70°	80°	90°	100°C	Untreated
Mean germination per cent	36	44	68	84	49	40

Within a fortnight, germination about twice that of the untreated seeds could be secured by directly steeping the seeds in water at 90°C for five minutes.

7. *Phyllanthus emblica* (Indian Gooseberry). This is an useful plant found scattered all over this province. The fruits are reputed to be the richest source of Vitamin C. The seeds are hard, angular, and brown in colour and are poor germinators. The seeds are extracted by drying the fruits in sun light for some days, when the carpels dehisce and liberate the enclosed seeds. The seeds require about two months storage after harvest for 'after ripening'. Attempts to induce germination in this period failed to achieve any success. Subsequently treatment of the seeds with hot water between 75 to 85°C for five minutes, over 80 percent germination was secured within ten days as against about 25 percent obtained with untreated seeds. The seeds vary very highly in their capacity to germinate and prior steeping in cold water is necessary to reject immature and sterile ones that float.

8. ***Mimusops hexandra*** (Pala). This is an evergreen wild fruit plant. The seedlings are used as a rootstock for sapota (*Achras sapota*) and the fruits are edible. The seeds vary in size and colour and the cotyledons are enclosed in a hollow thick seed coat. The seeds require over a month's 'after ripening' after extraction. Split seeds showed over ten percent germination although 15 percent were damaged in spliting the seeds with a wooden hammer. Steeping the seeds in water for five minutes at 80°C induce about 10 per cent germination within a fortnight as against one or two per cent obtained with untreated seeds.

9. ***Zizyphus jujuba*** (Ber). This is a hardy fruit plant found scattered all over the province and requires very little attention in its maintenance. Select and choice plants are generally propagated by budding on seedlings. The fruits are round and the endocarp enclosing the seeds exceeds one fourth inch in thickness. They do not give more that 2 per cent germination even after two months. The seeds are extracted by breaking the stony coat or endocarp with an iron hammer against a hard surface. About 30 per cent damage or loss is inevitable even with careful extraction. The extracted naked seeds when soaked in water at varying temperatures, the following germination was obtained within a month.

Temperature ...	60°C	70°C	80°C	90°C	100°C	Untreated
Mean germination per cent	6	39	9	3	...	2

Pre-treatment of the extracted seeds with hot water at 70°C for five minutes gives a high percentage of germination as against a meagre percentage obtained with the hard stony coat in tact.

10. ***Medicago sativa*** (Lucerne). This is widely used in all countries as a fodder crop and is generally fed to horses and milch cows. The seeds are minute, reniform and fairly hard coated. Midgely (1926) has reported that these seeds germinate better when kept in moist condition for several months. Several other methods have also been suggested by other investigators to overcome impermeability in lucerne.

By steeping the seeds in warm water at 50°C for five minutes, over 50 per cent germination can be secured within four days as against 30 — 40 per cent obtained with untreated seeds. At higher temperatures germination is inhibited and the embryo does not withstand the heat.

Summary and Conclusions

Seeds of some economic plants subjected to heat pre-treatments at varying temperatures for an interval not exceeding 5 minutes, give different response in germination; in all cases the treated seeds showing greater germination per cent than the untreated ones.

The table below gives the summery of performances of the economic plants tried here.

Name of plant.	Temperature of water in C.	Time of treatment	Mean germination per cent Treated	Untreated	Period or Interval.
		Minutes.			
1. Lucaena glauca	70	5	78	24	10 days
2. Tephrosia purpurea	90	5	70	13	2 ,,
3. Crotolaria juncea (Sunnhemp)	70	5	96	14	24 Hours
4. Prosopis juliflora (after shaking with sand)	70	5	78	12	3 Days.
5. Delonix regia	85	5	75	24	14 Days
6. Delonix elata	90	2	40	14	14 ,,
7. Mimusops hexandra (Pala)	80	5	10	14	14 ,,
8. Phyllanthus emblica (Indian Gooseberry)	80	5	82	20	10 ,,
9. Zizyphus jujuba (with naked seeds)	70	5	39	2	30 ,,
10. Medicago sativa (Lucerne)	50	5	52	35	4 ,,

II. Optimum germination is obtained with treatment for five minutes in water ranging between 70 to 80° C in many of the plants reported here.

III. At higher temperature over 80° C, only wild indigo and *Delonix elata* have shown better response in germination than at lower temperatures indicating that the thicker the seed coat, the higher is the temperature required to induce maximum permeability.

IV. Still higher temperatures between 90 to 100 C, or at boiling point of water, the seed coat looses its resistance and in many seeds very poor germination has been recorded; this temperature being detrimental to the vitality of the embryo.

V. Temperatures between 50 to 70° C though induce better germination than the control are not sufficient to induce maximum permeability.

VI. Heat pre-treatment through water induces the seed coat to swell and causes permeability and promotes the development of the embryo. Simultaneously it facilitates the penetration of the radicle through the softened seed coat.

VII. In some hard coated seeds, heat treatment by itself fails to induce permeability but accelerates the pace of germination after scarification. In *Prosopis juliflora* prior scarification is necessary by grinding with sand and further treatment with hot water increases the pace of germination. In *Zizyphus jujuba* and *Mimusops hexandra* intermediate fruit coats are stony and do not allow moisture or the expansion of the embryo. The breaklng of this coat is necessary prior to heat treatment to allow the ingress of water and the development of the embryo.

From the foregoing, it is clear that heat through water at varying temperatures is a feasible means of inducing permeability in hard-coated seeds of some economic plants. Otherwise, in these seeds germination fails to occur normally till water penetrates in to the seed coat. The pace of germination is generally quickened with the breaking of the dormancy and impermeability induced by heat. Seed permeability in several other hard coated seeds not tried so far is also likely to be facilitated by such pre-treatment resulting in quicker and higher germination. Depending upon the thickness of the seed coat, the harder the seed coat, the higher is the temperature required for inducing permeability. In still harder seed coats, breaking of the fruit coat or other structure which acts as a barrier is needed. Optimum permeability without any deleterious effects on the embryo is generally secured with five minutes treatment irrespective of the range of temperature. At higher temperatures beyond 80° C, generally treatment for periods longer than five minutes has been found to be definitely deterimental to the embryo. At temperature below 80° C, treating the seeds beyond five minutes period does not induce appreciably higher permeability or greater germination. This has been already indicated by the author with *Lucaena qlauca* (1948). The emergence of the radicle penetrating the seed coat, has been taken as the sign of germination. In field trials, longer periods are required as the seedling is seen only when the germination phase is nearing its end.

Wherever there was low germination at temperatures over 80° C, in general, it was observed that the embryoes are devitalised or killed due to heat shock and in many cases at 100° C, or boiling point of water, most of the seeds get cooked. Proper care and adequate caution are therefore required in observing the temperature and in adhering to the limits specified which generally does not exceed 5 minutes for securing maximum germination without any untoward effects. The seedlings from heat treated seeds were found in all cases coming up like the normal plants and injurious effects if any resulting in the death of the embryo or intermediary effects as set back in growth or wilting of the seedling are not seen.

At present there is universal shortage of all commodities. Seeds are priced high and are not available in adequate quantities especially when a drive for more planting and increased food production is a-head. It is felt that by adopting the above methods, more plants

can be secured in a very short time out of the available and wastage in seed can be eleminated through such an exploitation. In the case of green manure crops which are generally sown after crop harvests or as intercrops under rainfed conditions, utilisation of the rapidly decreasing moisture in the soil, is an essential requisite for successful crop production. The above methods of seed pretreatment remove the erstwhile handicaps and facilitate in the case of green manure crops like Sunnhemp and Wild Indigo maximum germination in as short an interval as possible and the successful establishment of the plants before the moisture dries off. It is hoped on account of the simplicity, and feasibility, the above methods will be widely adopted by the agriculturists.

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Varieties and Propagation Methods of Sweet-Potatoes in South India.

By

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The species *Ipomoea batatas* Poir is known nowhere in a wild state. The cultivated form is derived from an allied species, *I. fastigiata* Choisy which is believed to have originated in West-Indies and Tropical America. The plant, being well suited for tropical countries, is extensively cultivated in the tropics of both the hemispheres. It is not adapted for cool climates and seldom thrives well over altitudes of 3,000 ft. The crop requires a warm moist climate in the planting and growing season and a dry sunny weather at harvesting time. Sweet-potato are grown only in one season in the Southern districts of Madras i. e., from September—October to February—April. In the Circars and Agency tracts it has generally two seasons, June to September—October and September—October to February—March. A similar practice exists in Malabar and parts of South Kanara.

Botanical description: *Ipomoea batatas* Poir, belongs to the family *Convolvulaceae* and is a perennial by habit, though it is treated as an annual in crop practice. It is a weak-stemmed, twining or trailing herb; leaves alternate, exstipulate, varying in shape but often ovate to orbicular in outline, cordate or truncate at the base, entire, shouldered, digitately lobed, or deeply cleft. Flowers axillary, cymose or solitary borne on short peduncles; calyx 5-parted, greenish imbricate, about half-an-inch long and persistent; corolla gamopetalous, funnel-shaped, 1½ to 2 inches long by 1 to 1½ inches wide at the mouth and light purple in colour; ovary superior, bicarpellate, 2 to 4 celled, 4-ovuled; fruit a capsule; seeds small slightly flattened and black. The adventitious roots are modified into tubers which store reserve food material.

Varieties: Though *Ipomoea batatas* flowers quite freely under South Indian conditions, it does not often set fruits and seeds. The non-setting of seeds is ascribed to the self-sterility of the flowers and this has made the breeding of new varieties a difficult task. But recently, by control treatments they have been induced to bloom and set viable seeds (3). It is also recorded that when two or more varieties are grown side by side they occasionally set seeds; in Japan by artificial cross-fertilization the setting has been increased from 16·3 to 58·1 per cent (5). The absence of free crossing and non-setting of seeds are mainly responsible for the limited number of varieties met with in *Ipomoea batatas*. Many present-day sweet potato varieties have originated as a result of bud mutations which take place rather freely in this species (2, 4).

There are about ten varieties that are commonly cultivated in Tropical America and among them many types have been recognised. Though the different varieties are classified commercially as the "dry" and "yam" types depending on the texture of the flesh of the tuber, there is no definite satisfactory classification based on morphological characters.

In South India there are two distinct varieties distinguished by the colour of the skin of the tubers—one with white skin and another with reddish skin. In both the varieties the pulp is white. The red variety which is supposed to be the earlier introduction of the two, is a hardier plant with robust vines, forming smaller tubers. The duration of the variety is shorter and the yield is also less than that of the white variety which forms bigger tubers. The tubers of the latter are more uniform in shape and a little more fibrous than the red variety and has a better keeping quality. In the red variety there is a form with light red or pink colour which is cultivated to a small extent in the Circars. The white variety on the East-coast and Central Districts is of one type without any variation, whereas four forms have been met with in this variety on the West-Coast districts. Though a variety with yellow pulp is said to be existing, it has nowhere been found so far. The following varieties and forms are cultivated by the ryots in the centres noted below :

	Centre	*Variety and forms*	*Distinguishing leaf characters*
I.	Coimbatore and Southern districts	Red variety	Leaves entire or with slight shoulders and without any pink colour on veins.
		White variety	Leaves prominently shouldered when young and often lobed in mature plants with pink markings on veins.
II.	West Coast districts	Red variety	Similar to the red variety in the other area.
		White variety Form I	Leaves lobed and often cut into five lobes; pink colour markings on veins; similar to the common white variety found in centre I. Known as 'mathras' around Kasaragode.
		Form II	Leaves deeply lobed into seven; rest similar to form I.

Centre	Variety and forms	Distinguishing leaf characters
	Form III	Leaves more or less entire with or without shoulders and without any pink colour on veins. Plant resembles red variety.
	Form IV	Similar to form III but with pink colour markings on veins. Locally known as 'nadan' around Kasaragode.
III. Vizianagaram	Red variety	Leaves more or less entire, with or without shoulders and with purple colour markings on veins.
	Light Red or Pink	Leaves shouldered; with light purple colour markings on veins locally known as 'kosta'.
	White variety	Leaves shouldered or lobed but without any colour markings on veins.

Propagation Methods: The propagation of *Ipomoea batatas* is mainly by vegetative means with cuttings taken from the vines. There are two ways by which the seed material or vine cuttings are prepared for planting in the regular season. The common method is to raise small plots of nurseries with cuttings got at the time of harvest. The vines from the first small nursery are again multiplied in a second bigger nursery after two or three months. In another two to three months the second nursery gives planting material for 15 to 20 times the area occupied by it.

In the second method, instead of planting the vine cuttings small unsaleable tubers are planted in the nursery. These tubers produce a number of shoots which arise from the axils of the lateral roots of the tubers in about 7 to 10 days after planting. The meristematic cells situated at the base of the fibrous lateral roots develop into shoots under favourable conditions. The small sprouts may be easily pulled out and transplanted in the field as is done in many parts of America (1). In South India wherever the nursery is raised from the tubers, the sprouts are allowed to develop into vines from which cuttings are obtained for the main crop.

After rejecting the mature bottoms, cuttings of 9 to 12 inches long with 3 to 4 nodes are usually taken from the vines. Longer cuttings than 12 inches produce very small tubers as a number of nodes get confined to a smaller area and thus retard tuber development. The vine cuttings can be safely stored in gunny bags without deterioration of viability for 2 to 4 days. The leaves are usually removed from the cuttings and it is a matter of natural response that such cuttings produce new growth more quickly than the cuttings with leaves. The cutting is capable of rooting at all the nodes that come into contact with the soil; the buds at the axils of each leaf develop into shoots. When the tender apical cuttings are planted the terminal bud unfolds the younger leaves and puts forth vigorous growth without drying up.

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2. Variation in soil texture within the first 6 feet of soil will lead to ununiform root distribution and development or may lead to unnecessary loss of moisture and plant foods. Drainage may also be imperfect on such soils.

3. A soil of the moderately open texture as a loam is preferable to open sandy soils or to stiff clayey soils.

4. Mere judging of soils by observing the surface is definitely misleading and most risky. In most cases a good surface soil may have a few inches below sheets of rock or impenetrable layers of kunker, stone or boulders, which will not permit roots to grow.

5. Soils varying in texture up to six feet depth within small distances are common, and these are not ideal for fruit growing.

6. All soils suspected of alkalinity or salinity or have to be irrigated with water which is not sweet, should be chosen only after the advice and opinion of a competent chemist are obtained.

7. Water table, which rises even on rare occasions, such as on an exceptionally heavy rainy period, to within 6 feet from the surface, will render the site risky for fruit culture.

Irrigation in Orchards.

1. Irrespective of the soil and the fruit, irrigation is dependent on the rainfall and its distribution. Irrigation has to necessarily therefore be based on a careful consideration of the soil moisture as influenced by the rains ; that is to say water should be applied only when soil moisture is deficient and trees show first signs of distress.

2. Under a given set of conditions, a light, open or sandy soil requires more frequent watering than other soils. Even so, shallow soils require more frequent applications of smaller amounts of water than deep soils.

3. When intercrops are grown, the tree requirements should be considered as supreme. It is therefore necessary to select intercrops, that would not conflict in water needs with the fruit.

4. The differential needs should be known. For instance, a crop like banana can stand and even welcome more frequent and larger applications of water than citrus trees.

Correspondence

I

Sir,

In the "Madras Mail" of about 9—2—1949 there is some news on rain making in Australia.

In about 1912 or thereabout, one Narasimmal Naidu (of a printing press, in C. B. T. R.), explained at Peelamedu the same thing, that is, a similar explanation was given for Rain Making.

A cold fluid, ice or water at 1 to 4 degrees centigrade is sprayed in the clouds and a 4 inch rain was got in Australia.

Instead of spending a 1000 crores of rupees for hugo tanks, one rain of some 4 inches can be got by spending a 100 or 50 rupees. for hiring an air plane and sprayiug some cold fluid.

I beg at least the Agricultural Department can try this experiment.

Avarampalayam,
Ganapathi P. O.,
Coimbatore.

Yours cordially,

A. P. KRISHNASWAMI.

II

Sir,

I have read carefully the article in your December issue — "The Economic Price of Paddy" by Sri Chidambaram Pillai, M. A., It is a pity that an article dealing with such an important question has been published without any editorial comment for I feel more muddled than ever, after reading it.

The gist of it is obviously that the price for procurement fixed by government is uneconomic and in support are given figures which have every appearance of careful and learned accounting. But they fail to convince me of anything, except that there is something wrong some where. May I put before you the main points which have intrigued me?

Firstly the value of the land is put at Rs. 6000/- an acre and so Rs. 270/- is added to the cost of production. Either, (a) this value has no relation at all to the productive capacity of the land and is simply an arbitrarily inflated figure; or (b) the land is so fertile as to be worth the value placed on (or paid for) it. If (a) is right, then the first thing to do to convert a loss into a profit is to place a correct value on the land and reduce the Rs. 270/- to some more reasonable figure and there you are with a nice profit in your pockets.

If on the other hand, the land is really worth the value put on it judging by its productive capacity, then :—

1. The ceiling price fixed is uneconomic because the cultivation is inefficient, or

2. the costing should be revised, or

3. the ceiling price should be increased.

The world position in regard to food is such — if we are to believe the frequent statements made by Sir John Boyd Orr — that land should no more be entrusted to an inefficient cultivator than you would entrust your Aeroplane to an inefficient mechanic. Tinnevelly is the only district in the province in which I have never set foot and so I know nothing about the efficiency of the Tinnevelly ryots. On the other hand, there are certain other figures in Sri Chidambaram pillai's statement which intrigued me.

Why the annual recurring item of Rs. 15/- for permanent improvements on land valued at Rs. 6,000/- per acre? Does gold require gilding? Why use 140 lbs. of seed per acre in such fertile lands? Even we use no more than 90 lbs. on our sands. Why pay Rs. 24/- in 1948 for 140 lbs. of seed when the agricultural Department supplied me with seed at 2 as. per pound?

Again, apparently, the straw which is breaking the Tinnevelly camel's back is iniquitous land tax of Rs. 28/- per acre. I have to pay Rupee one per acre which I bought in 1944 for Rs. 60/-, whereas, land worth Rs. 6,000/- per acre is taxed Rs. 28/-. Calculating on an 'Ad Valorem' basis I am paying a tax of Rs. 100/- while Sri Chidambaram Pillai pays only Rs. 28/- on a capital of Rs. 6,000/-. This reminds me of the story of an American which I read the other day. He visited a circus where he saw a camel. He picked up a straw and placed it on the camel's back. As nothing happened he was noticed walking away shaking his head and muttering "wrong straw".

But let me cut the story to save this trouble Mr. Editor. So just one final point. Mr. Pillai pays only Rs. 1/8/- for a cart-load of cattle manure. Owing to the paucity of cattle and their miniature size and to the serious competition for the little cattle manure available from growers of native (chewing) tobacco, we have to pay anything from Rs. 20/- to Rs. 25/- per cart-load. Yet in what was barren sand four years ago I am now finding that even the 1947 price is not at all uneconomic while the 1948 price recently fixed (i. e. from 1st November 1949) leaves a nice little profit for me.

Sir Albert Howard said 'The Arsenal of Democracy is fertile soil'. It is dangerous to entrust an Arsenal to inefficient users.

Y. R. Farm,
Nileshwar,
March 8, 1949.

Yours truly,

R. M. Savur.

Agricultural News Letter

January, 1949.

Manuring and Irrigation. On the black clayey soils of the Bellary District, Sorghum (*Cholam* or *Jonna* or *Jowar*) and cotton are the main crops that are grown. In the rain fed conditions, the normal acre yields have been 450 lbs. of sorghum. By irrigation alone, the yield was increased to about 900 lbs. but when irrigation was combined with adequate manuring, the results were still better. Sorghum, manured at 60 lbs. nitrogen per acre, and irrigated, gave an acre yield of 2,244 lbs. of grain and cotton, manured at 80 lbs. nitrogen, gave a return of 672 lbs. per acre of unginned cotton. Further work is in progress. The indications are that where crops are irrigated, there is need to manure the land as well, in order to get the full worth of irrigation.

Summer Paddy Crop. The majority of paddy grown in this province is after summer, when water supplies are assured after the monsoon rains. But to a small extent paddy is grown in the season known as Kar and also in the season Kuruvai. In tracts, where the percentage of the area of Kar or Kuruvai crop could be large, the yield of paddy is also high. In this season, the following have been some of the outstanding yield records obtained from the harvest in September last. The paddy strains, known as Ambasamudram 1, 2 and 7, have recorded yields of 3550, 3310 and 3610 lbs. per acre. The strain ADT. 3 has given an acre yield of 3300 lbs. which may be said to be the record so far at the Pattukottai Station. Therefore, one of the means to enhance the yields of paddy in this province would be to increase the area that could be grown with either Kar or Kuruvai paddy varieties.

Thaladi Paddy crops. In very many fields, the standing young Thaladi crop, especially those transplanted late in the season, remains stunted in growth and some cultivators are of the view that it is due to "Soorai" caused by meal bugs. But a closer examination would reveal that the central shoots of the infested plants or tillers are dried up, which is due to the attack of the paddy stem borer. A top dressing of Ammonium sulphate at the rate of about 100 lb. per acre would considerably improve the situation. Fortunately, one or two tillers invariably survive in each clump, even after a severe infestation of the pest and such surviving plants could be invigorated to tiller profusely by the application of ammonium sulphate. No time should, however, be lost hereafter for the application of the fertilizer. As the borer moths are attracted in large numbers to bright light at night, light traps would prove to be a useful remedial weapon, if all the ryots of a locality would adopt it in their common interest. Moths are attracted to light in larger numbers during dark nights than during moon-light nights. Local Agricultural Demonstrators may be consulted if necessary, for the setting up of the light traps.

Attack of Thrips, A timely spraying of the affected nurseries of Samba and Thaladi paddy with tobacco decoction, accompanied by a dressing of ammonium sulphate at 100 lb. per acre, considerably helps to put down the attack of thrips. The cost of spraying a 10 cent nursery which will plant an acre, will be Rs. 1—8—0.

Piricularia. From the variety of paddy known as Mologolukulu two cultures No. 2555 and No. 2202 have been found to be highly resistant to the blast disease known in Telugu as "Medavirupu" and in Tamil as "Kollai Noi". These two cultures are suitable for the district of Nellore and for the adjoining areas. In 1947 - 48 when this disease was severe in Nellore, the two cultures displayed a very high resistance to the disease and yielded 20 to 40 per cent over the local variety of Mologolukulu. They have been named BCP. 1 and BCP. 2 respectively and are being multiplied in an area of about 10,000 acres in this season. The farmers of the Nellore district hereafter need not suffer any loss by the incidence of the fungus, Piricularia, on paddy.

Sweet Lupin. A substitute for red gram, which will come up in higher elevations and milder climate, is under cultivation at the Agriculturas Research Station, Nanjanad. This is known as "Sweet lupin" (Lupinu angustifolius). It is a 7 month crop that is sown in April and harvested in October and November for seed purposes. The seeds can be used in the place of peas, while green, and in place of dhal, when dry. It can also replace horse gram for cattle feed. This is a suitable green manure crop for hills and produces remarkably large nodules of nitrogen fixing bacteria, which enrich the soil. A green manure crop sown with 100 lb. seed per acre would give 10,000 lb. of green material as manure, when harvested prior to the flowering stage. It is a boon to Nilgiris district where the soil is poor in plant food and organic matter, so essential to support good plant growth. Small quantities of seeds of this dual purpose crop can be obtained from the Superintendent, Agricultural Research Station, Nanjanad.

Karunganni Cotton. By way of further improvement over the earlier strain, a new one called "K. 2 cotton" which is vigorous and quick growing, has been evolved for general distribution. It gives 15 per cent more yield than the local mixture and about 3 per cent over the earlier strain K. 1. K. 2 is able to withstand the ill effects of untimely rains in January and February, which cause heavy shedding of flowers and immature bolls. K. 2 bears big bolls which open well, making it easy for quick and clean harvest; has a good staple length capable of spinning up to 28's standard warp counts. The strain would yield a higher income up to Rs. 20 per acre over the return of the local cotton. There is a scheme for the rapid multiplication and distribution of this improved cotton. Cotton growers of the Tinnevelly tract would do well to take full advantage of the scheme.

Sea Island Cotton. Sea Island cotton, grown by a farmer of Udipi in his backyard, was sown early in July 1947 in the Agricultural Research Stations at Pattambi and Taliparamba in Malabar and Nileshwar and Kankanadi in South Kanara District. Harvests were completed by October and November and the plants were ratooned in May 1948, leaving a stump of 9" from the ground. These ratooned plants put forth quick vigorous shoots, grew to a height of 2½' to 3½' and bore on an average of 25 bolls, yielding 2½ to 3½ ozs. of kapas per plant. The opening of bolls, was very satisfactory and the quality of cotton was fine, strong with a staple length of 1·56".

Harvest of Sugarcane. The determination of total solids in the sugarcane juice by a simple Brixometer, giving an index of sucrose per cent in the juice, can be done by any sugar cane grower. In the case of a variety like Co. 419, the maximum Brix's reading would vary from 20 to 22 per cent, depending on the season and soil conditions. If mature cane is to be tested by trial boiling of the cane juice, Co. 419 may be considered to be mature, when the recovery of the jaggery is 12 per cent of the cane weight. Ordinarily, the age of the crop would give reliable index of the maturity of the cane. Co. 419, which is largely cultivated in this province, would be mature, if harvested when it is 11½ months from the date of planting if the planting was between February and April; but in a crop planted in June, maturity is attained in 10½ months.

Plio Film. Plio film, a synthetic plastic product looking like glassine paper. affords proof against moisture and high permeability to carbon-di-oxide. Trial with this new wrapper has given very promising indications of assisting the fruits to remain in a better state of preservation than that left untreated i. e. for two to three weeks.

Education in Agriculture. In the re-organised scheme of secondary education, agriculture and gardening has been prescribed as one of the subjects for vocational courses of study from forms IV to VI. One of the schools that has adopted agriculture both as craft and as a vocational course of study is the Sivaswamy Iyer High Shcool, Tirukattupalli, Tanjore where about 40 pupils are taking instruction in agriculture. About 30 acres of poramboke was alienated by the Government and it was made fit for cropping by the school authorities, with the help of modern mechanical equipment. About 20 acres have been planted with paddy and 7 acres have been reserved for horticulture.

Campaign against Insects. Conservation of the enormous stock of food grains against the insect hordes has ceased to be a problem by a judicious use of Gammexane and D. D. T. dusts. In the field, Gammexane D. 025 literally decimates serious insect pests like grasshoppers on paddy and sugarcane, the rice bug, the cholam earhead bug, the sugarcane fly, flea beetles, termites and a host of other insects. D. D. T. appears to

have a more or less specific action against leaf eating grubs, termites and a variety of household and livestock pests. Two pounds of D. D. T. 550 wettable powder, mixed in 100 gallons of water, will be enough to spray an acre of paddy infested with paddy jassid. The annihilation of the pests sure in the course of three days and the cost works out at about Rs. 6/- per acre.

Sorghum Earhead Bug. The experience at the Agricultural Research Station, Siruguppa, shows that if D. D. T. wettable powder is mixed with water and sprayed at 1 per cent strength, with the help of an ex-A. R. P. stirrup pump fitted with a nostle, when the Sorghum crop is in the short blade stage, the ill-effects of the Sorghum earhead bug are got over.

Cattle Vaccination. The results of Brucellosis Vaccinations conducted during 1945 in a herd at Sethumadai of Coimbatore district were successful. The protected heifers had conceived and calved normally, and none of them aborted, fresh tests were made with 161 samples or sera from the same village of which 29 proved positive.

Immunity against Rinderpest. The Hon'ble Dr. S. Gurubatham Minister for Firka Development and Prohibition, inaugurated on December 12, 1948 at Penduriti, Vizagapatam district, a campaign of mass inoculation against rinderpest. The Hon'ble Minister personally inoculated the first pair of bullocks, which were brought there, for immunity against rinderpest.

February 1949.

Agricultural Prospects Brighter than ever. Several Agricultural problems of vital nature, that are likely to be faced, when the Tungabadra Project comes into operation, are being studied at the Irrigation Research Station, Siruguppa.

A good portion of the project area is made up of deep black soil and the tract, in general, receives low and uncertain rainfall.

It has now been established, that no harm will result to the black soil due to irrigation with Tungabadra river water by rise of harmful salts. It is also interesting to note that as a result of timely irrigation with adequate manuring, yields of crops appreciate many fold compared to yields of crops depending solely on the uncertain and untimely rainfall. Figures given below need no comment, and speak for themselves, as to the great potentiality of the famine areas of the Ceded District coming under the Project.

	Jonna (Sorghum)		*Cotton*
	Grain	Straw	Kappas.
Rainfed ...	401	981	387
Irrigated ...	450	1387	367
Irrigated & manured ...	2244	7106	672 (SON)
Irrigated no-manure (60—N) ...	913	5300	290

An Improved Bunch Type of Groundnut in Sight. The popular bunch variety of groundnut extensively cultivated in the Guntur and the Pollachi areas of this Province has one great drawback. Rains during harvest result in a good portion of the nuts germinating in the field itself due to non-dormant habit and entail loss to growers and affect the quality of the produce. This problem has been under study by the Oilseed Specialist. The high yielding hybrid culture A. H. 6481 does germinate not even, if the weather is wet during harvest. It will soon go through large scale trial in the district before release for general distribution.

Setting in Plum Orchards Solved. At the Pomological Station, Coonoor setting of plum trees, Shiro, being a self infertile variety is usually very poor. It had unusually a good crop in 1948 for the first time. This is attributed to the fact that another new variety from Kotagiri planted in between the rows of Shiro four years back flowered for the first time. It is found that the new variety of plum inter-planted proved a good polliniser for Shiro. Grafts of the new variety are being multiplied for large scale distribution for inter-planting in gardens planted with Shiro and securing regularly a good crop of plums.

A Sceptic Fruit Nursery—Man Converted to the Correct method of Propagation of Fruit Plants. In 1944 a nursery man in Srirangam has been following the whip-cum-inarching method for securing mango graft on a large seale. It was suggested to him to either prefer inarching or alternatively the root stocks might be lopped 4″—6″ above the graft joints at the time of grafting. For the past two years, he had taken up the latter suggestion with profit and has been successfully raising hundreds of grafts, as it contributed to a high " take ".

An Improved Strain of " Budama " (Cucumis Trigondus) A-18 of Nandyal. In the Nandyal Valley of the Kurnool District, a vegetable locality known as BUDAMA (a variety belonging to the cucumber family) is a regular mixture, with Korra (Tenai, Setaria Italica) and Red Gram, in dry lands at the rate of half to one ounce of seed per acre. It matures in three months and an average of 500 lb. of ripe fruits are gathered per acre. It is usually cut out into chips and dehydrated in the sun for use as a vegetable during summer. A slection in this variety named A. 18 with eliptical fruits of scarlet yellow colour has been isolated for distribution.

Propagation of Jak Made Easy. Propagation of Jak through seed is not only a slow method, but the plants do not also turn to be true to the parental characters. Experiments at the Fruit Research Station, Kallar have shown that Jak could be easily propageted by grafting. It will therefore be a quick method of propagating on a large scale Jak varieties which are known to possess very desirable characters for yield, quality of fruit etc. The fruit section will be highly thankful to people who will communicate the location of such special varieties.

A Rare Type of Ragi. The grain of the finger millet (Ragi - *Eleusine Coracana*) is brown in colour. A new type with white grain was discovered at the Millet Breeding Station, Coimbatore. It contains twice as much protein and 50% more vitamin than the brown ragi under cultivation. But as ill luck would have it, it is poor in yield. Research work is in progress at the Millets Breeding Station, Coimbatore through hybridisation to build up brown ragi rich in proteins and vitamin.

Measures to check rust Disease in Tenai. Rust is a serious disease that often attacks the Italian Millet. This is spotted out by the characteristic brown rusty spots on the leaves. In certain adverse seasons, the disease assumes an epidemic form and results in a severe loss to the farmers. Extensive survey of the varieties cultivated in various tracts of the Province was undertaken and a larger collection made. During the course of the intensive study of these materials, a type least susceptible to the disease and recording fairly high yield has been isolated. It is under yield test.

On the way to check striga - a root Parasite on Sorghum. Striga (Sudumali or Malli) is a flowering root parasite on many cereals. Sorghum is highly susceptible to it. The parasite attaches itself to the root of the Sorghum plants and sucks the nutrients going up to the formation of grains on tho ear head. It therefore results in a low yield. Sometimes the Sorghum plant dies when a number of striga plants attaches itself to the host.

An African type of Sorghum resistant to this pernicious parasite has been isolated at the Millets Breeding Station. But to our disappointment, the grain of the resistant type is unpalatable. So a programme of hybridisation between the resistant type and the local cholam varieties has been put into execution and selections combining the desirable qualities of the local varieties and the resistant character of the African type are being tested.

Glut in the fruit market and unsalable fruits need not worry the orchardists. A heavy crop of fruit often results in a glut in the consuming markets. Naturally the prices offered to the grower are low. This a part, a good portion of the harvest does not often come to the grade standards or cannot be quickly marketed.

All these wastes can be turned to good profit if side by side a fruit canning and preservation unit is set up as a side cottage industry to an orchard or groups of orchards in fruit producing centres.

At the Government Fruit Products Research Laboratory, Kodur, Cuddapah District, a three months practical training is given in upto-date fruit canning and preservation methods to students of S. S. L. C.

standard. Fruit products like Orange, Lime and Lemon squashes, Lime juice, Cordials, Fruit Jams, Jellies and Marmalades of excellent quality are now produced at Kodur. Why then the orchardists should hesitate to take advantage of the Institution ?

Choose intelligently Plants for your orchard. Twenty Himayuddin grafts supplied from Sugarcane Research Station, Anakapalle were planted in the year 1943 by Dr. Ramamurthy, Anakapalle in his garden at Kasimkota about three miles from Anakapalle, with a spacing of 40" on either side in the squire system. The trees have started commercial yields since two years consequently and the yields of the trees have worked out to 250 to 300 fruits per tree. This is a striking departure in the general performance of most of the trees of the variety Himayuddin which are known to be shy bearers as a class. The importance of the selection of clones for orchards from the choice and selected type of parent tree is evident from this experience.

Nursery growers can economise. As a result of trials conducted at the Agricultural Research Station, Taliparamba, regarding the use of various containers for potting and despatching seedlings, coconut fibre containers have been found to be convenient and cheap. These are found to reduce the potting expenses by 50% when compared to bamboo pots and by 25% when compared to mud pots. In the despatch of plants, coconut husk containers hold three times more number of plants per basket when compared with mud pot containers and twice the number of plants when compared with bamboo containers. Plants potted in coconut husk containers stand transport bétter than those in bamboo or mud pots. Further, the damage to the grafts through whiteand is considerably minimised by using coconut husk containers for potting seedlings, grafts or budding.

An improved Fruit grading machine. A machine for grading tight jacket oranges designed by the Research Engineer and based on an old chinest design has for sometime past been fairly In common use. It was however felt that the high cost of this machine (Rs. 175-) placed it beyond the reach of many small scale fruit growers. Further research on this subject was made and an improved and cheap grader has now been designed. The new grader is made in two sizes, the smaller for grading limes and the larger for grading tight jacket oranges and lemons. The smaller size costs approximately Rs. 50- and the larger Rs. 120.

In the Chinest pattern, the fruits are transferred one stage to the next by means of a pedal to be operated once for each such transfer. Hence the process is not one of continuous grading.

In the new grader, the fruits are fed at one end and the grading takes place as they roll down a gradient, under the force of gravity.

The fruits are graded according to "Agmark" sizes. One boy operating this machine can grade from six to seven thousand fruits in one hour. Fruits are neither crushed nor damaged in the process.

Visual Education of Farmers in Improved Methods of Agriculture. Regular tours are organised for farmers selected from the various parts of the districts and taken to the different Agricultural Research Stations to educate them on the latest 'methods pursued to increase the yields of various crops and also to acquaint themselves with the latest improved agricultural implements. The tour usually covers a period of two weeks and the entire cost is borne by the Government.

Side lines of Farming for Profit and Pleasure. Bee-keeping is one of the side lines of farming which could be undertaken both for profit and pleasure by the agriculturist. A hive is capable of producing 8 to 10 lb. of honey per annum. The farmer can supplement his income by Rs. 24/- to Rs. 30/- per hive. East Godavari District in this Province has maximum number of hives numbering over 1,200 maintained exclusively by the cultivators. A Bee-Keepers Co-operative Society is also functioning at Pithapuram which helps in the marketing of honey. The industry is getting popular among the agriculturists in that district. Farmers in other districts may follow this with profit.

"Korai Weed" can be kept under Check. Korai (*Cyperus rotundus*) is a pernicious weed in almost all the red and sandy soils. It gets naturally propagated by nuts which develop in the soils. The nuts contain the nutrients required for the growth of the grass and shoots come out from each of them when conditions are favourable. In an experiment conducted at the Central Agricultural Research Station, Coimbatore, it was found that the nuts are developed mostly within two feet depth of the soil. When the field is cultivated once in a fortnight during the fallow period either with Guntaka or with a plough, the weed is kept in check and the subsequent crop raised in the monsoon is not infested so much as in the case of the uncultivated plot. Cultivators are therefore advised to plough the field soon after the harvest of a crop and work a Guntaka or a cultivator once in a fortnight during the fallow period. Since a Guntaka can cover 3 to 4 acres in a day, it will be economical to work this implement.

Gleanings

Storing of Fertilisers: Chemical fertilisers are to-day of importance not merely because they allow farmers to farm more economically, but because they are indispensable for intensive cultivation. Consequeutly, the problems of the fertiliser industry are of importance not only to makers and users of fertilisers but to the whole world.

One such problem recently became urgent and its speedy solution by British scientists is already having important results in the use of fertilisers. It concerns the caking of fertilisers when they are stored—at first sight a trivial problem, but in fact one of very great practical importance in food production.

Every farmer knows that if he puts bags of fertiliser into store the contents tend to cake into a hard mass like cement. This occurs especially among the bags at the bottom of the pile, which get squashed the most, and when, as often happens, the storeroom is not warm and dry. This is a serious problem because fertiliser must be evenly applied to get the best results and this is impossible unless it is in the form of a free flowing powder. The difficulty is particularly great when it is to be drilled simultaneously with the seed. The farmer has to waste a busy season when he can least afford to do so.

Two Solutions: The industry has already found two ways of solving the problem, but, unfortunately, the demand for fertilisers is now so huge that the solutions cannot be applied to the industry's total output. One solution is to store fertilisers in huge bins and deliberately allow them to cake. Then they are ground up a second time and it is found that there is then little caking tendency left. This was quite feasible as long as the demand for fertilisers was seasonal—chiefly in spring—because this left several months of the year free for them to mature in their bins. Now, however, the demand for more and more fertilisers is incessant. Production takes place all the year round and the huge storage space required for this method is no longer available.

The second solution to the problem is to form fertilisers into little hard granules which do not stick together nearly as easily as the usual fine crystals. However, as well over a million tons of fertilisers are used every year in Britain alone, there is not—nor is there likely to be for a long time—nearly enough machinery to deal in this way with more than a fraction of the flood of material.

Because of the urgency of the problem, chemists of the Department of Scientific and Industrial Research were asked to find a solution quickly—in fact within eight months. This short time limit immediately disposed of any ideas chemists may have had about making a thorough laboratory study of all the factors involved and then proceeding logically to a remedy. Instead, they had to apply all their scientific knowledge and intuition to finding by rule of thumb means some remedy—not necessarily the best or the only one—which would quickly relieve the situation.

Caking Tendency: Firstly, they had to work out a way of measuring the degree of caking. This was finally done by measuring the pressure necessary to make specially prepared cakes crumble up. The more severe the caking the greater the pressure needed to break it up again.

Next, it was decided that the most likely way of solving the problem would be to mix into the fertiliser some powder which might keep the crystals apart and so stop them from caking. It is perhaps much the same idea as dusting newly amended tyre puncture with chalk to stop the inner tube from sticking to the cover.

The powder they sought, apart from minimising caking, had to fulfil a number of conditions. It had to be possible to add it to fertiliser during the dry mixing process, it had to be harmless to plant and soil, cheap and available in the U. K. in quantities of

10,000 to 15,000 metric tons a year. Not all substances tried out would fulfil these conditions, but it was essential to examine a sufficient range in order to obtain some idea of the types of material which might be serviceable.

With little to guide them, the chemists patiently tried the effect of mixing various powders into the fertiliser and then they measured the caking tendency of the product. The powders they tested were extraordinarily varied and included fish meal, brick dust, powdered seaweed, sawdust and dried blood.

Best Agents: Powders of mineral origin—such as brick and stone dust—proved quite useless. Indeed, they made matters worse rather than better. Finally, shredded peat or sawdust were found to be the best agents, reducing caking to between one-third and one-fifth of what it was when no conditioner was present. Chopped straw is just as effective but not so easy to handle. The addition of peat or sawdust—about one part in 30 is needed—will not lower the value of fertilisers because manufacturers always add a small quantity of filler to make the proper balance between different plant nutrients. All that will be necessary will be to replace a part of the filler with sawdust or peat.

Quite apart from the anti-caking agent, storage conditions too are important. Bad storage and exposure to weather can cause much more severe caking than when fertiliser is kept dry.

It seems a far cry from the prevention of an apparently minor defect in a product the general public rarely sees, to an important increase in the world's food supplies. Nevertheless, this is the result which will be obtained, for the new discovery means that far greater quantities of fertiliser will be available for the farmer in good condition at the time they are needed. (British Information Service / 341).

Weeds May Become Assets: Agriculturists in Australia believe that at least three weed pests can be turned into profitable crops. There is a strong possibility that the saffron thistle (*Carthamus lanatus*) which is on the Australian list of prohibited noxious weeds will be cultivated as a crop. The seed has good oil properties and is valuable as turkey feed. One firm of oil and fodder cake manufacturers is buying seed at 6 pence a lb. Last year when harvesting experiments were carried out with saffron thistle, it was found that the crop could be reaped with a normal harvester provided that every alternate tooth was removed from the comb. The seed is larger than wheat grain and must be harvested before absolutely ripe or the oil content deteriorates.

Samples of another weed, *Sida rhombifolia* or common sida, are being sent to England to discover whether the plant can be used in place of Indian jute for making hessian and sacking. Experts believe that the fibrous nature of the plant should make it suitable for sack-making. Experiments with the seed of wild turnip (*Brassica tournefortii*) for the extraction of oil promise a use for this weed, now considered a menace by wheatgrowers. A South Australian miller who is already exporting large quantities of mustard seed oil to India and south-east Asia claims that he has produced equally good oil from wild turnip seed. The oil has the same purity (98 per cent), tastes sweeter, has clearer colour and will not go rancid. It can be used for culinary purposes and as a base for perfume and cosmetics, while the residue makes good laying mashes for poultry farmers. AGN. / 227.

Rain by Radar: Radar is being used by a group of Australian scientists from the Council for Scientific and Industrial Research in experiments with the object of making rain. They are concentrating on three phases:

(1) Studies of the effect of "seeding" clouds with dry ice pellets (2) study of clouds structure (3) Development of instruments to measure physical conditions in and around cloud.

There are, however, many problems to face. Speaking on the experiments, the Minister in charge of the Council for Scientific and Industrial Research, the Hon. J. J. Dedman said: "First you have to find the clouds. Then there is the prospect that some people in the area chosen for rain-making do not want rain, and the question arises whether the Government will be liable for damages for causing rain to fall". (AGN./227)

New Farm Compost: In Australia, a Municipal Council is turning garbage into an organic manuring material, similar to compost. Garbage rich in discarded food is preferred. After picking over for tins, metal and glass, the garbage passes by conveyor belt to a hopper. Here bacterial seed, in earth, and a small amount of lime, are added and the mixture conveyed to the bacterial digester. In this 50-ton container, the matter is slowly stirred and mixed together for two days. The bacteria, it is claimed, converts the garbage into good manure, which Government analysts say will eventually turn into compost From 100 tons of garbage about 50 tons of marketable product is obtained. This sells at £A5/15/- a ton bagged or £A3/15- in bulk. A quantity of the manuring material has already been sold to the Murrumbidgee Irrigation Area in New South Wales, and 500 tons are on order for banana growing at Coffs Harbour, northern New South Wales. (AGN./229).

Butter-Tainting Weeds Traced: After an Australia-wide survey of all weeds believed responsible for tainting butter, scientists have isolated three plants which they consider do the most damage. Weeds are: *Coronopus didymus*, (lesser swine cress or carrot weed); *Lepidium hyssopifolium*, (pepper cress, mustard weed or pepper wort); *Lepidium beonariense*, (rubble pepper cress and mustard weed). Weed taint causes thousands of tons of Australian butter each year to fall below the choicest standard quality Officers of the Australian Council for Scientific and Industrial Research, the Queensland Butter Board and the Queensland Department of Agriculture and Stock have made an extensive study of weed taint at Gatton College, Queensland. Plants selected from the Australia-wide survey as being most likely to impart taint to butter were used in feeding trials. At the same time, laboratory tests were carried out in an effort to eliminate taint from butter. Now that the three weeds causing the most trouble have been discovered, dairy farmers have been advised to eliminate them from grazing paddocks, and to conserve fodder as alternative feed-stuffs for cows so that their intake of tainting plants will be reduced. So far no satisfactory method of extracting taint from butter in the factory has been evolved. (AGN./228).

More Tomatoes from Spray Irrigation: Quickening Australian farmer interest in spray irrigation and rapid engineering advances in this method have prompted experiments in the Murrumbidgee Irrigation area of New South Wales, which show that spray irrigated tomatoes grown on heavy soil give better yields than furrow irrigated plants.

Comparative yields were:— Furrow irrigated 6·4 tons to the acre.

Spray irrigated 10·1 tons to the acre.

In the first month, when furrow irrigated plants were receiving more water than spray irrigated plants, growth was more rapid in the former because of rapid initial soakage in the freshly made furrows. Towards the middle and end of the season, however, the spray irrigated plots rapidly overtook and surpassed the furrow irrigated ones. The experiment established that spray irrigation of vegetables on heavy soil is both practical and economic and is distinctly advantageous where moderate salting is present. (AGN./228).

Toxaemic Jaundice Discovery Made: Agricultural scientists in Australia have discovered that heliotrope weed (*Heliotropium europaeum*) causes toxaemic jaundice in sheep This weed had often been suspected as a poisonous plant, but laboratory tests and experiments with groups of sheep had failed to prove that it caused jaundice. This was because the poison takes a long time to work through the blood stream to the liver and it is only when the poison accumulates in the liver that it proves fatal. Toxaemic jaundice has killed off many crossbreed sheep in Australia in the last 20 years. Now that one of its causes has been discovered, fat lamb production can be expected to increase. (AGN. / 228).

Agricultural College and Research Institute Library, Lawley Road, Coimbatore.

MONTHLY LIST OF ADDITIONS FOR FEBRUARY 1949

1. BURTON (W. G.): Potato a survey of its history and of factors influencing its yield, nutritive value and storage — 1948
2. COLLINGS (Gilsort H.): Commercial Fertilisers, their sources and use Edn. 4. — 1947
3. FLETZ (David): Atomic enegy now and tomorrow. — 1946
4. EASTER (Stophen S.): Preservation of grains in storage: papers presented at the International meeting of infestation of food-stuffs, London 5th—12th August 1947. — 1948
5. FAULKNER (Edward H.): Ploughing in prejudices. — 1948
6. GILBERT (Frank A.): Mineral nutrition of plants and animals. — 1948
7. HABLER (Agaes W.): Garden in the plains Edn. 3. — 1948
8. HAYES (B. C.): Techniques of Observing the weather. — 1947
9. KENT JONES (D. W.) and AMOS (A. J.): Modern Cereal Chemistry Edn. 4. — 1947
10. LYON (T. Lyttleton) and BUCKMAN (Hary O.): Nature and properties of soils Edn. 4. Revised by Harry O. Buckman. — 1948
11. MARKLEY (Klare S.): Fatty acids, their chemistry and physical properties — 1947
12. RANGANATHAN (S. R.): Preface to Library Science. — 1948
13. RANGAPPA (K. S.): and ACHAYA (K. T.): Chemistry and manufacture of Indian Dairy Products. — 1948
14. SHAW (K. T.) *Ed:* Land policy, Agricultural Labour and Insurance — 1948
15. SMITH (K. M.): Text book of Agricultural Entomology Edn. 2. — 1948
16. WHITE (John M): Farmers Handbook. — 1948
17. BRITISH MYCOLOGICAL SOCIETY: 1896—1946: Proceedings of the Jubilee Meeting held in London 20—25 October 1946. — 1948

Crop and Trade Reports.

Statistics—Cotton—1948—'49—Second Forecast Report.

The average area under cotton in the Madras Province during the five years ending 1944 '45 represents 10·7 per cent of the total area under cotton in India. The area under cotton upto 25th September 1948 is estimated at 3,76,000 acres. When compared with the area of 3,72,400 acres estimated for the corresponding period of last year, it reveals an increase of 1·0 per cent.

Central Districts and the South—Mainly Cambodia Tract: The area in the Central districts and the South relates partly to the last year's crop and partly to the current year's sowings which have commenced in parts. The area in this tract fell from 68,500 acress to 5,57,000 acres i.e., by 18·7 percent, mainly due to want of adequate rains at the time of sowings.

Westerns Tract: The area under Westerns increased from 2,21,900 acres to 2,41,300 acres i.e., by 8·7 per cent. The increase is due mainly to an increase is due mainly to an increase in the area under Hingari Cotton in Bellary District (21,000 acres).

White and Red Northerns: The area under white and Red Northerns increased from 27,100 acres to 27,700 acres i.e., by 2·2 per cent.

Warangal and Cocanadas: The area under Warangal and Cocanadas fell from 51,900 acres to 48,800 acres i.e., by 6 per cent, as the sowings were delayed due to late receipt of rains.

The condition of the Crop is reported to be generally satisfactory except in the districts of Bellary and Anantapur where the yield is expected to be below the normal due to delayed and inadequate rains. The crop in the Bellary District is also reported to have suffered from an attack of hairy caterpillar pest in the early stages.

The average wholesale price of Cotton lint per Imperial Maund of 82,2/7 lbs. (equivalent to 3,200 tolas) as reported from important markets on 16th October 1948 was Rs. 44—1—0 for Cocanadas, Rs. 41—15—0 for Westerns (Mungari), Rs. 81—13—0 for Coimbatore Cambodia, Rs. 71—3—0 for Coimbatore Karunganni, Rs. 69—5—0 for Virudhunagar Karunganni, Rs. 57—12—0 for Tinnevellies and Rs. 52—8—0 for Nadam Cotton When compared with the prices published in the last report i.e., those which prevailed on 11th September 1948, those prices reveal a rise of approximately 5% in the case of Cocanadas and Coimbatore Karunganni and 8% in the case of Coimbatore Cambodia, and a fall of 6% in the case of Virudhunagar Karunganni and 5% in the case of Nadam Cotton. The price remained stationary in the case of Westerns (Mungari).

Statistics—Crop—Sugarcane—1948—Third or Final Report:

The average area under sugarcane in the Madras Province during the five years ending 1944—'45 represents 3·4 per cent of the total area under sugarcane in India.

2. The area planted with sugarcane in 1948 is estimated at 2,08,840 acres. When compared with the corresponding estimate of 2,47,430 acres for the previous year and the actual area of 2,72,680 acres according to the Season and crop report for 1947—'48, the present estimate reveals a decrease of 15·6 per cent and 23·4 per cent respectively. The estimate of the previous year was below the actual area by about 9·3 per cent.

3. 42,190 acres have been reported as sown since the last forecast was issued in October 1948, made up of 6,760 acres in the Circars, 5,800 acres in Deccan, 6,060 acres in the Carnatic, 19,800 acres in the Central districts, 3,100 acres in the South and 670 acres in the West Coast,

4. The estimated area is the same as that of last year in Guntur. An increase in area is estimated in Krishna and Malabar and a decrease in all the other districts of the Province due mainly to a general fall in the price of jaggery at the time of planting. The decrease is marked in Bellary (-4,820 acres), South Arcot (-10,080 acres), Central districts (-32,790 acres) and Mathurai (-7,650 acres).

5. The present estimate includes an area of 20,750 acres under ratoon sugarcane in the districts of Vizagapatam (200 acres), West Godavari (5,400 acres), Krishna (1,000 acres), Bellary (3,500 acres), Anantapur (800 acres), South Arcot (2,100 acres), Chittoor (4,000 acres), North Arcot (200 acres), Tiruchirapalli (1,500 acres), Mathurai (1,900 acres) and Malabar (150 acres).

6. The harvest of the crop has commenced. The yield per acre is expected to be normal in Tirunelveli, Malabar and South Kanara and below the normal in the other districts of the Province due mainly to the fact that the crop has been affected adversely by want of adequate rains during the growing period.

The seasonal factor for the Province as a whole is estimated at 89 per cent of the normal as against the estimate of 90 per cent in the Season and Crop report of 1947—'48 and 89 per cent in the final forecast of the previous year. On this basis, the yield is estimated at 5,253,890 tons of cane, the gur equivalent of which is 579,490 tons, as against an estimate of 680,770 tons in the final forecast report of the previous year and 6,818,380 tons of cane with a gur equivalent of 753,430 tons according to the Season and crop Report of 1947—'48. The present estimate reveals a decrease of 23·0 per cent in case of cane and 23·1 per cent in the case of gur as compared with the figures in the Season and crop report of the previous year.

7. The wholesale price of Jaggery per Imperial Maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important market centres on 12th February 1949 was Rs. 17—13—0 in Erode, Rs. 16—3—0 in Tiruchirapalli, Rs. 15—10—0 in Salem, Rs. 13—3—0 in Vellore, Rs. 12—8—0 in Mangalore, Rs. 11—2—0 in Bellary, Rs 10—13—0 in Adoni, Rs. 10—5—0 in Chittoor, Rs. 10—1—0 in Vizianagaram, Rs. 9—14—0 in Rajahmundry, Rs. 9—1—0 in Kakinada, Rs. 8—14—0 in Vizagapatam. When compared with the prices published in the last report, i. e., those which prevailed on 18th December 1948, these prices reveal a rise of approximately 29 per cent in Bellary, 10 per cent in Kakinada, 9 per cent in Chittoor and 7 per cent in Vellore and a fall of approximately 39 per cent in Vizagapatam, 8 per cent in Vizianagaram, Rajahmundry and Tiruchirapalli and 1 per cent in Salem, the prices remaining stationary in Adoni, Erode and Mangalore. (From Public and Economics Statistics Dept.)

Cotton Raw, in the Madras Province: The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February, 1949 to 4th March, 1949 amounted to 4,311 bales of 400 lb lint as against an estimate of—bales of the total crop of 1948—'49. The receipts in the corresponding period of the previous year were 18,350 bales. 38,077 bales mainly of pressed cotton were received at spinning mills and 959 bales were exported by sea while 22,665 bales were imported by sea mainly from Karachi and Bombay. (From Director of Agriculture, Madras).

Weather Review—For February 1949.

RAINFALL DATA.

Division	Station	Actual for month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpore	Nil	—0·9	Nil
	Calingapatam	0·2	—0·4	0·3
	Vizagapatam	Nil	—0·9	0·4
	Anakapalle*	Nil	—0·1	0·2
	Samalkot*	Nil	—0·3	Nil
	Kakinada	0·1	—0·2	0·1
	Maruteru*	Nil	—0·1	Nil
	Masulipatam	Nil	—0·5	Nil
	Guntur*	Nil	— †	Nil
	Agri. College, Bapatla	Nil	—0·4	Nil
	Veeravanam (College Farm)	Nil	...	Nil
Ceded Dists.	Kurnool	Nil	—0·3	Nil
	Nandyal*	Nil	Nil	Nil
	Hagari*	Nil	—0·1	Nil
	Siruguppa*	Nil	—0·3§	Nil
	Bellary	Nil	—0·2	Nil
	Rentichintala	Nil	...	Nil
	Cuddapah	Nil	—0·1	Nil
	Anantharajpet*	Nil	—0·1	Nil
Carnatic.	Nellore	Nil	—0·2	Nil
	Buchireddipalem*	Nil	—0·5	Nil
	Madras	Nil	—0·4	Nil
	Tirurkuppam*	Nil	—0·8$	Nil
	Palur*	Nil	—0·4	Nil
	Tindivanam*	Nil	—0·1	Nil
	Cuddalore	Nil	—0·9	Nil
Central.	Vellore	Nil	—0·3	Nil
	Gudiyatham*	Nil	—0·2	Nil
	Salem	0·1	—0·2	0·1
	Coimbatore (A. C. R. I.)*	0·1	—0·1	0·1
	Coimbatore (C. B. S.)*	Nil	—0·1	Nil
	Coimbatore	Nil	—0·4	Nil
	Tiruchirapalli	Nil	—0·5	Tr.

Division	Station	Actual for month in inches	Departure from normal in inches	Total since January 1st in inches
South.	Negapatam	Nil	—0·8	0·5
	Aduturai*	Nil	—0·4	Nil‡
	Pattukottai*	Nil	—0·4	0·4
	Mathurai	Nil	—0·5	0·9
	Pamban	Nil	—0·9	6·2
	Koilpatti*	1·3(x)	+0·8	1·9
	Palamcottah	0·7	—0·5	1·0
	Ambasamudram*	Nil	—1·2	1·2
West Coast.	Trivandrum	Nil	—0·8	0·3
	Cochin	Tr.	—0·8	Tr.
	Calicut	Nil	—0·7	Nil
	Pattambi*	Nil	—0·1	Nil
	Taliparamba*	Nil	—4·2	Nil
	Nileshwar*	Nil	—0·1	Nil
	Pilicode*	Nil	—0·2‡	Nil
	Mangalore	Nil	—0·2	Nil
	Kankanady*	Nil	—0·1	Nil
Mysore & Coorg.	Chitaldrug	Nil	—0·1	Nil
	Bangalore	0·3	Nil	0·3
	Mysore	Nil	—0·2	Nil
Hills.	Mercara	Nil	—0·2	0·1
	Kodaikanal	0·1	—1·4	1·0
	Coonoor*	Nil	—2·1	Nil
	Ootacamund*	Nil	—0·3	Nil
	Nanjanad*	Nil	—0·6	Nil

Note :—

(1) * Meteorological Stations of the Madras Agricultural Department.
(2) Average of ten years data is taken as the normal.
(3) $ Average of six years data for Tirurkuppam, and seven years for Pilicode is given as normal.
(4) § Taluk office rainfall is Nil
(5) ... Figures not available.
(6) ‡ The actual total from 1—1—49 is 0·03".
(7) Tr. = Trace - ActualRainfall is 0·01" for Tiruchirappalli and between 0·1" to 0·4" for Cochin.
(8) (x) Actual rainfall is 1·25" and that too received on one day i.e., on 10—2—49.
(9) † Actual figure is 0·02".

Weather Review for February 1949.

A number of western disturbances occurred over Punjab and Sind in the first week of the month under review.

On 6—2—1949 a cold wave was found moving through the West Central Provinces, Berar, Saurashtra and Cutch and the northern half of the Bombay Province where night temperatures had fallen appreciably. The next day it enveloped Saurashtra and Cutch, the central parts of the country, the whole of the Bombay Province and the Hyderabad State. On 7—2—1949 the night temperatures were as much as 10° to 16° F. below normal in the north Bombay Deccan, the West Central Provinces and Berar. On the same day Malegaon recorded a minimum temperature of 38° F. This cold wave extended on 8—2—1949 eastwards into North-East India and southwards into the Madras Deccan and the north Madras Coast where there had been large falls in night temperatures. The next day it became unimportant.

The elongated trough of low pressure over the sub-montane districts of the United Provinces and Bihar, noted on 18—2—1949 became noticeably marked two days later and unimportant on the fifth day,

The weather throughout the Madras Province in the month of February 1949 was practically dry. Day temperatures were generally below normal. Night temperatures happened to be invariably above normal in Tamilnad and Andhradesa. Towards the end of the month night temperatures became below normal while the days were warmer than usual. On 10-2-1949 a few showers occurred in South Kerala and adjoining Tamilnad. Periodic appearance of mist or fog over Mysore Plateau was the main feature of the weather conditions during the month under review. The note-worthy fall in the Madras Province occurred only at Koilpatti on 10-2-1949 to the tune of 1·25". M. B. V. N & C. B. M.

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Departmental Notifications

GAZETTED SERVICE—APPOINTMENTS

Sri A. R. Seshadri B. Sc. (Hons.) is appointed as Assistant Entomologist, Singampatti

The following subordinates appointed as Superintendents of Liaison Farms in Sugar Factory areas are posted to the Centres noted against each.

Sri C. Ekambaram, Farm Manager, Gudiyattam, ...	Hospet
,, C. S. Krishnaswami Ayyar, Teaching Assistant in Agriculture, Coimbatore ...	Nellikuppam
,, M. Lakshmikantham, Agricultural Demonstrator, Yellammanchilli ...	Samalkot
,, S. Ramaswami, Special Agricultural Demonstrator, Vellore ...	Pugalur

POSTING AND TRANSFERS.

Name of Officers	From	To
Sri Ananthapadmanabha Pillai, R.	P. A. to D. A. O., Vellore,	Agronomist, A. R. S., Siruguppa.
,, Jagannatha Rao, C.	Assistant Cotton Specialist, Bellary,	Cotton Specialist, Coimbatore.
,, Seetharamiah, P.	Assistant in Agronomy, Anakapalle,	Assistant Agronomist, Anakapalle.
,, Veerabhadra Rao, K.	P. A. to D. A. O., Nellore,	D. A. O., Anakapalle.

II. SUBORDINATE SERVICE.

NEW APPOINTMENTS.

Name of Officers	From	To
Sri Suryanarayana K	...	F M., A. R. S.. Koilpatti.
Miss. Santha Raghavan,	...	Assistant in Botany, Coimbatore.

POSTING AND TRANSFERS.

Name of Officers	From	To
Sri Chiranjeevi, V	F. M , Araku Valley,	A. D., Sompeta.
,, Doraiswami, G.	A. D., Virdachalam,	A. D., Trichengode.
,, Krishnamurthi, R.	A. D., Conjeevaram,	A. D , Papanasam.
,, Krishnaswami Sarma, M. C.	A. D , Melur,	F. M., A. R. S., Palur.
,, Krishniah V. V.	Ento. Myco. Training,	A. D., Gudur.
,, Kanaka Rao, G.	Entomology Assistant Plant Protection Scheme, Bellary,	F. M., Araku Vally.
,, Lakshmipathi Rao, V.	Ento-Mycology Training, Coimbatore	A. D., Maduranthakam
Mr. Maqbaboor Rahiman,	,,	Mycology Assistant, Nellore.

Name of officers	From	To
Sri Narayana Reddy, M. L.	On leave,	A. D., Chodavaram.
„ Nageswara Sarma, D.	Mycology Assistant, Nellore,	A. D., Rapur.
„ Nagaraja Rao, K. R.	Assistant A. R. S., Siruguppa,	Assistant DDT. Scheme, Coimbatore.
„ Ponniah, J. H. S.	F. M., A. R. S., Palur,	A. D., Ambasamudram.
„ Rama Rao, S.	A. D., Gudur,	P. A. to D. A. O., Nellore,
„ Rajagopalan, V. T. R.	Assistant in Entomology, Coimbatore,	Assistant in Entomology, Nellikuppam.
„ Ranga Rao, K.	Ento-Mycology Training, Coimbatore,	Teaching Assistant in Agriculture.
„ Rama Mohan Rao, K.	Ento-Mycology Training, Coimbatore,	Entomology Assistant, A. R. S., Anakapalle.
„ Ramanjaneyulu, S.	Ento-Mycology Training, Coimbatore,	A. D., Koilkuntla.
„ Satyanarayana, T.	A. D., Trichengode,	Special A. D., Sendarampalli.
„ Satyanarayana K.	A. D., Koilkuntla,	A. D., Chirala.
„ Subba Raju, A.	Ento-Mycology Training, Coimbatore,	F. M., Liaison Farm, Samalkot.
„ Sundaresan, K. R.	A. D., Tirukoilur,	F. M., Liaison Farm, Nellikuppam.
„ Sapthariah, K.	Assistant in Paddy, Coimbatore	Assistant in Paddy, A. R. S., Aduthurai.
Miss. Sarojini Dhamodharam,	On leave,	Assistant in Mycology, Coimbatore.
Mr. Syed Muhammad, D. A.	On leave,	P. A. to D. A. O., Vellore.
„ Sundara Rao, Y. R.	Assistant in Fruits,	Inspector for the enforcement of Fruit products.
„ Uttaman, P.	Assistant in Paddy, A. R. S., Aduthurai,	Assistant in Paddy, Coimbatore.
„ Venkatarama Reddy, T.	Ento-Mycology Training,	F. M., Liaison Farm, Hospet.
„ Viswanandam, Y.	Ento-Mycology Training, Coimbatore,	Entomology Demonstarator, Bellary.
„ Venkatasubramanian, V.	On leave,	A. D., Ambasamudram.